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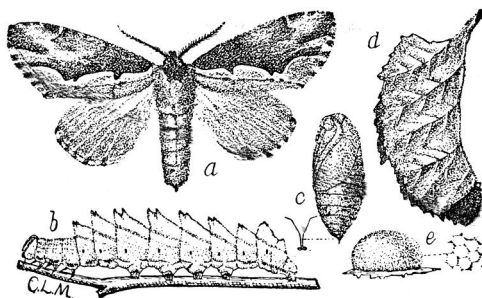
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## No. 2.

|                                        | <i>Parts<br/>per 1000.</i> |
|----------------------------------------|----------------------------|
| Potassium.....                         | .0192                      |
| Sodium.....                            | .0386                      |
| Lithium.....                           | Trace.                     |
| Calcium.....                           | .5215                      |
| Magnesium.....                         | .0947                      |
| Alumina.....                           | .0104                      |
| Iron.....                              | Trace.                     |
| Sulphuric acid (SO <sub>4</sub> )..... | 1.6546                     |
| Chlorine.....                          | .0595                      |
| Boric acid.....                        | Trace.                     |
| Silica.....                            | .0143                      |
| No carbonates present.                 |                            |

## NOTES ON THE EARLY STAGES OF THREE MOTHS.

BY C. L. MARLATT, STATE AGRICULTURAL COLLEGE, MANHATTAN, KANSAS.



NERICE BIDENTATA WALKER.

*a*, moth; *b*, larva; *c*, pupa; *d*, pupa-case of folded leaf; *e*, the egg, enlarged, with outline of the surface pattern, much magnified. Excepting *e*, the figures are of the size of nature.

Eight or ten nearly full-grown peculiar saw-backed larvæ, which proved to be of the above-named moth, were collected on young elm-shoots growing in the College grounds, September 13, 1887. A number of whitish, hemispherical eggs with irregular openings at the apex through which the larvæ had escaped, were found on or near the eaten leaves, attached singly to the upper surface of the leaf.

Cocoons of stout, brownish silk were constructed by the larvæ shortly after collection (Sept. 14-21) in folded leaves, or under some slight protection at the surface of the soil, concealed by particles of earth.

A considerable time elapsed before the pupal stage was assumed.

Moths appeared May to June, and deposited eggs in the breeding-cage exactly similar to those found on the leaves the previous September. The eggs failed to hatch, much to my regret, and the early larval changes cannot be given. It is safe to assume, however, that this moth is double-brooded—the moths from which my specimens were obtained probably appearing about the first of August.

I have failed to find any reference to the early stages of this insect in the entomological works at my command, and the following descriptions of early stages are given in the belief that they have not hitherto been recorded:

*Egg*: .9x.55 mm. Shape, hemispherical, with a broad flattened base, irregularly encircled by a whitish cement, fastening it to the leaf. Surface shining, apparently smooth, but when highly magnified is found to be covered with raised lines inclos-

ing minute polygonal, usually 6-sided, areas. Color, honey yellow; after hatching, nearly white.

*Mature larva:* Length, 32 to 35 mm. Head, resinous, slightly bilobed—a narrow brownish stripe marking each lobe in front. Mouth-parts light, mandibles tipped with dark. Body moderately robust, especially at center. Thoracic segments small. Abdominal segments 3-11, armed dorsally with large, fleshy bi-toothed elevations, increasing in size from 4th to the 6th segment, then diminishing to the 10th. The elevation on the 11th segment is considerably larger than that of the preceding segment, and has but one point. Tips of all the protuberances, crimson. Body, greenish: upper half of sides washed with white, interrupted by a central dorsal hyaline line, and an oblique hyaline line extending from the dorsal suture to the lower edge of the white on each segment.

A dull, crimson band marks the lower edge of the thoracic segments, and segments 11 and 12, continuing on the last to the tips of the anal prolegs. A spot of the same color marks the lower edge of segments 4, 5, and 10.

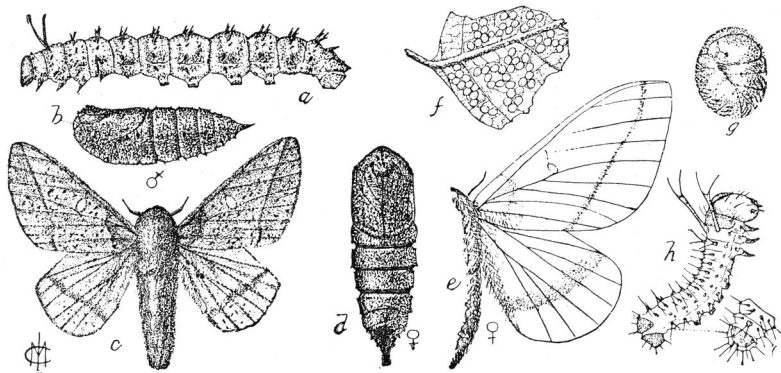
Abdominal feet exteriorly dull crimson, transversely lined with black.

Thoracic feet resinous, with a brownish line or dot on the outer side.

Venter, greenish. Stigmata, black.

*Pupa:* 16x6 mm. Robust; dark reddish brown; last segment armed with a shining spine, forked, and recurved at the tip (see fig. c)—(wanting in one specimen, uniformly present in 4 others examined). Wing and feet cases, etc., extend nearly to the posterior margin of the 4th abdominal segment, and are deeply rugose. Abdominal segments punctate, shining: the three sutures including the 5th and 6th abdominal segments prominent, edges produced into minute ridges.

Stigmata elongate, not prominent.



ANISOTA STIGMA FABR.

a, larva full grown; b, pupa of male; c, male adult; d, pupa of female; e, outline of right half of female adult; f, eggs on oak leaf; g, egg near hatching, showing larva within; h, newly-hatched larva with detail of supra-anal plate; g and h much enlarged; the other figures the size of nature.

During August and September the gregarious larvæ of the above-named moth are quite commonly found on our native oaks, feeding in companies of ten to fifty or more. The leaves are eaten entire, except coarser veins, even by newly-hatched larvæ; and limbs and small trees are frequently entirely defoliated by more mature worms. On falling, the young larvæ attach a thread to the leaf by means of which it may be regained; half-grown to mature larvæ have not this habit, and are not easily induced to fall. After attaining full size, early in September, the larvæ enter the soil an inch or more and construct earthen cocoons, in which the pupal stage is assumed seven or eight days later.

Moths emerge late the following summer, July 1st to 15th; and after pairing, deposit eggs in compact groups of 10 to 50 on the lower surface of oak leaves.

Larvæ appear eight or nine days after the eggs are deposited; and, before reaching maturity, moult or shed their skins four times. The first moult occurs after a feeding period of about five days, the second to the fourth after eight to ten days, and about nine days elapse after the fourth moult before they become full-fed and enter the soil.

The following is a record of a cluster of eggs deposited on a leaf of *Quercus prinus* July 11th, 1888:

July 20, larvæ.

August 4-5, first moult.

August 12-13, second moult.

August 20-21, third moult.

August 30-31, fourth moult.

September 9-11, full-fed.

September 14-16, pupæ.

#### DESCRIPTIONS OF EARLY STAGES.

*Egg*: Yellowish; oval flattened, 1.7x1.5x1 mm.; apparently smooth, shining; under high power marked with indistinct polygonal raised sculpturings. Before hatching, the brownish head outline of the body, location of spines, etc., of the larva are visible.

*Young larva*: Length, 3.5 mm.; head, large, .8 mm. wide, 1 mm. long, reddish brown; thoracic and anal plate, large plates on anal prolegs, tubercles and spines, dark reddish brown; general body color, yellowish. The body is armed with hairs and spines as follows: Two large spines 1 mm. long, forked at the apex on the dorsum of the 2d segment; below these on either side is a two-forked spine, and a substigmatal twin spine; spine on 3d segment the same, but the dorsal spines are not larger than the others; on the following segments the dorsal and subdorsal spines are one-pronged, and a small spine or hair appears below and posterior to each of the dorsal spines; on the 11th segment, one central dorsal two-forked spine is found; head, thoracic and anal plates, armed with hairs (or spines). Stigmata, light brown.

*Larva after first moult*: Length, 10 mm.; spines on second segment 2.3 mm. long, not much forked; spines of body relatively shorter; all spines tuberculate, tubercles bearing minute hairs; color of spines, bluish black; of head and body, reddish; the latter yellowish above, and marked with a subdorsal yellowish stripe; stigmata, black; feet and plates on prolegs, dark.

*Larva after second moult*: Length, 12 mm.; spines on second segment, 4.5 mm.; body colors darker than in previous stage; a wide, brownish dorsal stripe, including the two dorsal spines on each segment, extends from the second segment to the middle of the last; this stripe is bordered with a lighter or yellowish color, which becomes darker gradually to the dark-brown stigmatal area; below the stigmata, light brown; a few whitish granules or minute tubercles are found on the anterior edge of the first segment, and on the spines.

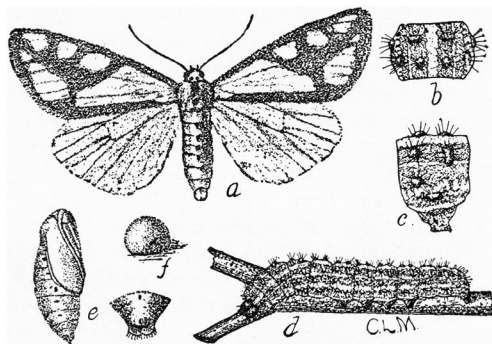
*Larva after the third moult*: Length, 16 mm.; spines on second segment, 7 mm.; tubercles on spines, and on segments, especially on anterior edge of first and posterior edge of last, white; colors as previously noted.

*After the fourth moult*: Length, 30 mm; full-fed, 40-45 mm.; spines on second segment, 6.5 mm. long, ends rounded, not two-pointed; white tubercles on spines and body quite prominent; a prominent transverse row on anterior and posterior edge of abdominal segments, and smaller ones scattered over the general surface;

spines, and transverse row of eight tubercles on anterior edge of first segment, and four on posterior and lateral edge of last segment, shining black; dorsal and stigmatal area, dark reddish brown, shading into the dull reddish of the subdorsal and substigmatal areas; venter dark brown, except narrow line at center, including thoracic feet and inner surfaces of prolegs; stigmata, large, velvety black, with narrow yellowish border.

*Descriptions of pupæ:* Female—Length, 35 mm.; width, 10 mm.; apical spine two-pronged, 3.5 mm. long; four prominent sharpened tubercles at the anterior extremity of body; extremities, and margins of the 5th, 6th and 7th segments armed with many sharp points; color, very dark reddish brown, almost black; general form as in *Anisota rubicunda*. Male—Length, 30 mm.; width, 8 to 9 mm.; apical spine, 3 mm.; other features similar to those of female.

*Parasites:* Immature larvæ were not infrequently found swollen posteriorly and attached to leaves or twigs by whitish silk. The swollen appearance was caused by the cocoon of an ichneumon parasite, spun within the body of the host larva. During the month of September, parasitic flies ( $\frac{1}{2}$  to  $\frac{3}{4}$  inch long, black, with red and white-marked limbs) escaped through circular openings cut near one extremity of the cocoon.



CALLIMORPHA SUFFUSA SMITH.

*a*, moth; *e*, pupa, side view, and tip of abdomen magnified; *d*, adult larva; *b* and *c*, middle segment of same from above, and from the side enlarged; *f*, egg, much magnified; figures *a*, *e*, and *d*, natural size, the others variously enlarged.

Early in April last, before the appearance of leaves, hairy lepidopterous larvæ  $\frac{3}{4}$  inch long, of a general dark color, striped longitudinally with yellow and white, were noted in moderate numbers crawling about the trunks and branches of ash trees on the Agricultural College farm. Later these larvæ were observed feeding, usually from the lower surface, on the young leaves of the ash.

A number collected May 1st completed larval growth May 17th, attaining a length of  $1\frac{1}{8}$  inches, and formed slight silken cocoons, exteriorly covered with particles of earth, at the surface of the soil beneath leaves, etc., in breeding-cage.

Pupæ were found May 31, from which the above-named moth was obtained June 27.

In June and July of the previous year, large numbers of these handsome insects were collected from the grass and weeds about and in the grove in question. A visit to the grove July 1, '88, was rewarded by the capture of but a single moth—a gravid female. This experience illustrates the often-observed fact in entomology, that the abundance of an insect in any locality one season is of little value in estimating the probable numbers for the next. Careful search at this time failed to show either eggs or larvæ on the trees or grass in the vicinity. From the moth captured, about 100 yellowish spherical eggs in two closely-placed, but not crowded masses, were

obtained July 2d and 3d. Young larvæ appeared July 9th, and were supplied with ash leaves and grass, but soon died.

In the hope of finding half-grown larvæ, the grove was visited October 21st, and three larvæ were found, after considerable search, feeding on the few dead leaves still hanging to some sprouts from the base of a few trees. A misty rain falling at the time, moistened the leaves so that they could be eaten by the caterpillars with little difficulty and apparent relish. The larvæ were 10–12 mm. long when extended in motion, and had the form and characteristic markings of full-grown specimens, except in being somewhat lighter colored, and having the subdorsal and terminal lateral stripes grayish white—not tinged with orange.

It is probable from the above, that this insect is single-brooded—wintering in the larval stage; and that the ash is its ordinary food plant. The fact that the weeds, *Eupatorium* sp. and *Solidago* sp., common in the grove, and the various perennial grasses thereabouts, were still more or less green, and yet untouched by them, is further evidence that the ash is the food plant of the young as well as the adult larva.

*Egg:* .75 mm. in diameter, nearly spherical, slightly flattened at base. To the unaided eye the surface appears smooth and shining, but with careful focusing with high power it is seen to be covered with raised lines forming a regular hexagon. Color, amber yellow, faintly mottled with a lighter shade.

*Young larva:* Length, about 2 mm.; head broader than body, resinous, armed with a few hairs; eye spots, black; piliferous tubercles, thoracic shield, anal plate and plates on abdominal feet, resinous; hairs, one to each tubercle, light colored, equaling the thickness of the body in length; tubercles on each of the thoracic segments 10, arranged in one transverse row, on abdominal segments except last, in two rows, 6 in anterior, and 4 in posterior row.

*Mature larva:* Length, 25–28 mm.; head somewhat less in diameter than the first thoracic segment, slightly bilobed, shining black, armed with a considerable number of black hairs; body, uniformly cylindrical, black, marked along the center of the dorsum by an orange stripe lighter colored between segments; a similar stripe, interrupted with black, covers the area just above and partly including the stigmata; a narrow, whitish-yellow line occurs midway of the dorsal and stigmatal orange stripe; and a similar line, curving down on the segments, borders the lower edge of the sides; area below the bordering lateral stripe, including the thoracic, and all but the inner surface of the abdominal feet, black, marked on each of the abdominal segments with an oblique yellowish spot; ventral surface within thoracic and abdominal feet, ashy, finely dotted with dark; segments armed with transverse rows of shining blue-black tubercles, which are covered with short, radiating hairs, both black and white, the black predominating on the dorsal, and the white on the lateral tubercles; stigmata, black.

*Pupa:* 15x5.5 mm.; dark reddish brown, robust, considerably enlarged back of the thoracic segments; last segment terminating in a produced semi-circular edge, slightly notched at the center, and armed with short, more or less forked hairs; wing-cases extend nearly to the posterior margin of the fourth segment; stigmata elongate, slightly elevated; general surface shining, abdominal segments minutely and sparsely punctured.

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#### OBSERVATIONS ON THE DIVINING-ROD.

BY EDWARD A. KILIAN, ALMA.

To the unprejudiced, without doubt it must be a fact that “water-witching,” as it is popularly called, is either a self-deception or an intentional fraud by those